

costvar, c
termvar, x, y, z, f
baseAttackTVars, b
index, i, j, k
 A, B, C, E, F, D, T

$::=$
 \mid Base
 $\mid A * B$
 $\mid A \odot B$
 $\mid A \sqcup B$
 $\mid A \multimap B$
 $\mid A \multimap\multimap B$
 $\mid (A)$

p
 $::=$
 \mid —
 $\mid x$
 $\mid p_1 * p_2$
 $\mid p_1 \odot p_2$
 $\mid p_1 \sqcup p_2$
 $\mid (p)$

t
 $::=$
 $\mid b$
 $\mid x$
 $\mid t_1 * t_2$
 $\mid t_1 \odot t_2$
 $\mid \text{let } p = t_1 \text{ in } t_2$
 $\mid t_1 \sqcup t_2$
 $\mid \lambda x. t$
 $\mid t_1 t_2$

Γ, Δ
 $::=$
 $\mid \emptyset$
 $\mid x : A$
 $\mid \Gamma(\Gamma')$
 $\mid \Gamma, \Gamma'$
 $\mid \Gamma_1 \blacksquare \Gamma_2$
 $\mid \Gamma_1 \bullet \Gamma_2$
 $\mid (\Gamma)$
 $\mid \Gamma$

$\boxed{\Gamma_1 \vdash \Gamma_2}$ Context Morphisms

$$\begin{array}{c}
 \overline{\Gamma \vdash \Gamma} \quad \text{C_ID} \\
 \\
 \frac{\Gamma_1 \vdash \Gamma_2 \quad \Gamma_2 \vdash \Gamma_3}{\Gamma_1 \vdash \Gamma_3} \quad \text{C_C} \\
 \\
 \overline{(\Gamma_1 \circ \Gamma_2) \circ \Gamma_3 \vdash \Gamma_1 \circ (\Gamma_2 \circ \Gamma_3)} \quad \text{C_A1} \\
 \\
 \overline{\Gamma \circ \emptyset \vdash \Gamma} \quad \text{C_U1}
 \end{array}$$

$$\frac{}{\emptyset \circ \Gamma \vdash \Gamma} \text{C_U2}$$

$$\frac{}{\Gamma(x : A, y : B) \vdash \Gamma(y : B, x : A)} \text{C_E1}$$

$$\frac{}{\Gamma(x : A \bullet y : B) \vdash \Gamma(x : B \bullet y : A)} \text{C_E2}$$

$$\frac{}{\Gamma(x : A \blacksquare y : B) \vdash \Gamma(y : B \blacksquare x : A)} \text{C_E3}$$

$$\frac{}{\Gamma(\Delta_1) \vdash \Gamma(\Delta_1 \blacksquare \Delta_2)} \text{C_WEAK}$$

$$\frac{}{\Gamma(\Delta \blacksquare \Delta) \vdash \Gamma(\Delta)} \text{C_CONTRACT}$$

$\boxed{\Gamma \vdash t : A}$ Attack Tree Logic (ATL)

$$\frac{}{x : B \vdash x : B} \text{L_VAR}$$

$$\frac{b \in \mathbb{B}}{\emptyset \vdash b : \text{Base}} \text{L_BASE}$$

$$\frac{\Gamma_1 \vdash \Gamma_2 \quad \Gamma_2 \vdash t : A}{\Gamma_1 \vdash t : A} \text{L_CTX}$$

$$\frac{\Gamma \vdash t_1 : A \quad \Delta \vdash t_2 : B}{\Gamma, \Delta \vdash t_1 * t_2 : A * B} \text{L_TENI}$$

$$\frac{\Gamma \vdash t_1 : A \quad \Delta \vdash t_2 : B}{\Gamma \bullet \Delta \vdash t_1 \odot t_2 : A \odot B} \text{L_PARAI}$$

$$\frac{\Gamma \vdash t_1 : A \quad \Delta \vdash t_2 : B}{\Gamma \blacksquare \Delta \vdash t_1 \sqcup t_2 : A \sqcup B} \text{L_CHOICEI}$$

$$\frac{\Gamma \vdash t_1 : A * B \quad \Delta(x : A, y : B) \vdash t_2 : C}{\Delta(\Gamma) \vdash \text{let } x * y = t_1 \text{ in } t_2 : C} \text{L_TENE}$$

$$\frac{\Gamma \vdash t_1 : A \odot B \quad \Delta(x : A \bullet y : B) \vdash t_2 : C}{\Delta(\Gamma) \vdash \text{let } x \odot y = t_1 \text{ in } t_2 : C} \text{L_PARAE}$$

$$\frac{\Gamma \vdash t_1 : A \sqcup B \quad \Delta(x : A \blacksquare y : B) \vdash t_2 : C}{\Delta(\Gamma) \vdash \text{let } x \sqcup y = t_1 \text{ in } t_2 : C} \text{L_CHOICEE}$$

$$\frac{\Gamma, x : A \vdash t : B}{\Gamma \vdash \lambda x. t : A \multimap B} \text{L_LIMPI}$$

$$\frac{\Gamma \vdash t_1 : A \multimap B \quad \Delta \vdash t_2 : A}{\Gamma, \Delta \vdash t_1 t_2 : B} \text{L_LIMPE}$$

$\boxed{t_1 \rightsquigarrow t_2}$

$$\frac{}{(\lambda x. t_2) t_1 \rightsquigarrow [t_1/x] t_2} \text{R_BETA}$$

$$\frac{}{(\text{let } x \circ y = t_1 \circ t_2 \text{ in } t_3) \rightsquigarrow ([t_1/x][t_2/y] t_3)} \text{R_LET}$$

$$\frac{}{(\text{let } p = t_1 \text{ in } t_2) t_3 \rightsquigarrow (\text{let } p = t_1 \text{ in } (t_2 t_3))} \text{R_LETC1}$$

$$\frac{}{(\text{let } p_2 = (\text{let } p_1 = t_1 \text{ in } t_2) \text{ in } t_3) \rightsquigarrow (\text{let } p_1 = t_1 \text{ in } \text{let } p_2 = t_2 \text{ in } t_3)} \text{R_LETC2}$$

Definition rules: 25 good 0 bad

Definition rule clauses: 36 good 0 bad